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(principles of action) wider than those expressed in previous civilization ; ideas demanding therefore new forms of embodiment and calling for new art, ideas which since they had not found embodiment for themselves appeared at the time to be hostile to all embodiment and thus to all art. The growing up of this distinction between commonplace reality and art seems to be due to just those historical periods when man has become aware of new principles of action just enough to condemn old action, but not sufficiently to secure expression for them. Commonplace reality, in other words, is simply the material which art has not yet conquered, which has not yet become a plastic medium of expression. Such a conception, indeed, is in line with Mr. Bosanquet's remarks about the future of art, when he says that in spite of the present apparent interruption of the art tradition, in spite of the fact that the discord of life has now cut deeper than ever before, we may feel sure that the human mind will find a way to resolve this discord and "the way to satisfy its imperious need for beauty." Two conceptions of art, finally, seem to be struggling with each other throughout Mr. Bosanquet's history : one of art as essentially a form of symbolism, the other of art as the expression of life in its entire range. The former can be reconciled with Mr. Bosanquet's fundamental philosophy only by a great stretch of the idea of symbolism ; it agrees, however, with the fixed distinction between commonplace reality and artistic reality, and at once lends itself to a conception of art which marks it off into a little realm by itself. The conception of art as expression of life leaves no room for any such division. Art becomes one with fulness of life. As Emerson says, "There is higher work for Art than the arts. . . . No less than the creation of man and nature is its end."

JOHN DEWEY.

The Sense of Effort. An objective study. By A. D. WALLER. Brain, 1891, pp. 189-249.

Report on the same by G. E. MÜLLER in the Z. f. Ps. u. Phys. d. Sinn., IV, pp. 122-138.

Dr. Waller's tone, in this essay, is modest, but his reasonings are too laboriously expressed. He suggests that experiments on the objective phenomena of muscular fatigue after voluntary movement may throw light on the vexed question of the peripheral or central origin of the feeling of effort. Effort is a sensation accompanying muscular action, fatigue a sensation following it. The concomitant feeling and the after feeling, Dr. Waller reasons, should presumably have the same organic seat, just as in vision an image and its after-image involve the same optic tracts. If experiments show the source of objective fatigue phenomena

to be central and not peripheral, then the subjective feeling of fatigue, as well as the feeling of effort, are probably non-peripheral in their origin. Thereupon Dr. Waller gives experiments which, as he thinks, show that the diminished efficiency of our muscles when we are fatigued by voluntary exercise must be more due to exhaustion of the volitional centres than to that of the muscles themselves. In these experiments, the state of the flexor-muscles of the fore-arm was observed in various ways :

(1) By the dynamograph, a short, stiff spring, which yields but slightly to the grasp of the hand, but has its deflections magnified by a long writing lever.

(2) By the ergograph, which records the heights to which a weight is raised by successive flexions of the middle finger.

(3) By the ponograph, which registers the upward spring of the finger when, in the middle of its flexion, it is suddenly set free from the weight.

(4) By the "bag-method," an elastic bag being fixed to the arm by a leather bracelet, and connected with a Marcy's drum. This records the "hardening" or *lateral* enlargement of the muscle, whilst the other three methods give its *longitudinal* variations.

The biceps muscle was also investigated by the ponographic method.

By alternating with each other series of voluntary contractions and series got by directly faradizing the muscle and nerve, Dr. Waller found that the voluntary contractions ran down at the end of each series from fatigue, rose again at the beginning of each new series in spite of the faradization-series which had intervened. Something then recovers from the fatigue of voluntary exercise, even though energetic contractions, peripherally induced, be still going on. Since, under these circumstances, the centre is the resting organ, it must be that the previously manifested fatigue had the centre for its seat. Conversely, Dr. Waller finds the faradic tracing to show a recovery at the beginning of each fresh series, and thinks this due to peripheral rest having taken place whilst the intervening series of voluntary contractions went on. To explain such a paradox, he invokes the "end-plate." The sinking observed during each voluntary series is partly due to expansion of the end-plate, and may mask a recovery of the muscle-tissue proper from previous faradic fatigue. Müller objects (pp. 124-6) that Waller's facts are inadequate to support these conclusions as to the recovery during voluntary contraction, though he agrees that the recovery during faradization exists, and points to a central seat for at least a part of the fatigue effect observed in the voluntary series.

By using Method 4 (the "bag-method") conjointly with the dynamograph, W. found that the lateral swelling or hardening of the muscle

gave parallel results, save that in the fatigued state the "lateral effects" are much less diminished in proportion than are the longitudinal ones, and that the spring is thus a much more sensitive indicator of fatigue than the bag. The maximal faradic shortening is much less than the maximal voluntary shortening, yet the "hardening" or lateral effects may be as great in the one case as in the other. The lateral effect slightly *outlasts* the shortening; and outlasts it considerably in fatigue, more especially in voluntary fatigue. It may in the latter case momentarily increase whilst the muscle is actually lengthening. These facts, according to W., point to the two distinct processes, lateral and longitudinal, in muscular contraction, which fatigue may dissociate. The protraction of the lateral process in voluntary fatigue he considers to show a continued influence from the fatigued centre, a "residual discharge" able only to harden but not to shorten the muscle. A cut-out frog's muscle also shows the lack of congruence of the lateral and longitudinal effects, for the shortenings successively diminish during faradic fatigue whilst the lateral effects show no such decline. Prof. Müller, on his part, entirely objects to W.'s interpretation of the results of his bag-method. It is contrary to generally received doctrines, he says, to suppose swelling without shortening in muscle, or hardening after inner tension has ceased. The records of Waller's "bag," he thinks, are due to contraction of antagonists, and to afflux of blood into the muscles, especially when the latter are faradically exercised. As for the frog's muscle, he points to the possibility of a mechanical elongation of the muscle's own length by its treatment as a sufficient explanation of Waller's results. This (which has been observed) would naturally give diminished tracings of shortening with undiminished tracings of swelling.

Dr. Waller finds still other peculiarities in fatigue. Using Method 3, that of the "ponograph," he finds the upward spring of an arm suddenly released from the weight it has been upholding to be greater in fatigue than when the arm is fresh. He considers that this fact is probably connected with the protraction (just described) of the "lateral effect" in fatigue, and that it looks, therefore, more like a residual central effect than like a peripheral effect. The centres, therefore, here again would seem to take the lead in voluntary fatigue. He finds, moreover, that when the two hands, one being fatigued, the other fresh, work simultaneously, each upon a dynamograph, the relaxations of the fatigued hand take place less promptly than in the other. W. candidly admits that all these phenomena may be, whilst M. insists that they probably are, purely peripheral in their origin.

W. then repeats and discusses experiments by Fick and Mosso which show that a maximal voluntary contraction, so far from being increased, is diminished when a faradic stimulation is added. The "step-down"

in the tracing is due, according to him, to contraction of the antagonistic muscles. The tendency of most of these results is to lead, according to Dr. Waller, to the view that the centres, getting fatigued first, cannot voluntarily overdrive their executive servants,—the end-plates and muscles.

Next Dr. W. reviews “with great reluctance” the experiments by which Bernhardt, Ferrier, and Brunton have compared our estimation of weights by voluntary and by faradic lifting. These have been quoted to prove that peripheral ‘muscular’ sensations are quite enough to account for what delicacy of discrimination we possess when ‘hefting’ weights. W. finds an enormous inferiority in the faradic method,—an inferiority even to the passive discrimination of weights by the skin of the supported hand, and such as can only be explained by a positively inhibitory effect, upon our ‘muscular’ sensations, of the faradic current used. W. also considers the anatomical proofs for the existence of sensory nerves in muscle-tissue to be inadequate.

He finally passes to the psychological question about effort. Testimony to the effect that effort can be introspectively analyzed into peripheral feelings he rejects as no better than testimony that we introspectively discern something non-peripheral. He does not, of course, deny the presence of afferent factors in effort and fatigue; but that they can be the only factors needed for the regulation of our outgoing exertions he considers disproved by the extreme rapidity with which such minute voluntary adjustments as those of the larynx have to be performed. Apparently there must be here some immediate central consciousness of what discharges are taking place. The outgoing currents must be measured out in advance of our feeling of their effects. In consequence of this consideration and of the part which his other experiments show to be played by the motor-centres in objective fatigue-phenomena, he concludes, as he began, that subjective fatigue and sense of effort must both have central seats, and that the feeling of the outgoing current which Bastian and others have denied must still be admitted to exist by psychologists. Müller, in concluding his report, points to the arbitrariness of Dr. W.’s assumption that objective and subjective fatigue must have one and the same seat. Objective fatigue might be largely in the centres, and yet our feelings of muscular fatigue might be due to the accumulation of waste products in the muscles exciting the nerve ends there. He ends with characteristic sharpness by saying that W. has shown by his so-called objective study how *not* to reach reliable results. Without going as far as this, I must confess that Dr. Waller’s fundamental assumption that objective and subjective fatigue and subjective effort must be held to have the same local seat seems to me singularly frail. I must also say that Müller’s criticisms of W.’s

experiments, especially of those made by the bag method, seem cogent. The paper confirms well what we already know, — that our motor centres get objectively fatigued. The only things in it which seem to throw any really fresh light on the question of the seat of the effort-feeling, are, first, the experiments which show that when our muscles contract faradically we largely lose the sense of how much we lift; and, second, the observations on the rapidity with which laryngeal and other minute innervations must be measured out. The latter remark is (so far as I know) a novel one, and, if it could lead to experimental treatment, it might be very important. Müller ignores it altogether.

W. JAMES.

Ueber den Hautsinn. By M. DESOIR. Separat-Abzug aus Archiv für [Anatomie und] Physiologie. 1892.

Dr. Dessoir has undertaken a thorough investigation of cutaneous sensibility. The work will fall, when complete, into three chapters, treating respectively of the temperature sense, the sensations of pressure and contact, with the muscular sense, and the common sensations. The present instalment consists of the first of these three divisions, to which is prefixed a lengthy discussion (70 pp.) of sensation in general. It is with this preface that I propose to deal here.

What differentiates sensation from perception? The author passes in review various definitions and determinations of the two terms. (1) According to Helmholtz, sensation is a simple subjective modification of conscious content, the effect of the operation of external causes on our sense-organs; perception is comparatively complex. Dr. Dessoir takes decided exception to the predicate of subjectivity. (2) A widely spread view distinguishes sensation from perception by reference to the different participation of consciousness in the two processes. Such a determination is rejected, partly because of the indefiniteness of the word 'consciousness,' partly because of our ignorance of the connection between sensation-act and sensation-content. The former objection is to me less strong than it is to the author; and the raising of the latter seems needless from the psychological point of view.¹ There are, however, others that might be urged. (3) Feeling has been made the determining moment. Or the sense-idea has been subdivided, the idea of the outer (perception) bringing always with it the idea of an inner (sensation or bodily feeling). Or the difference is a difference on the intellectual side: perception is sensation *plus* attention, or association, or consciousness, or memory-images. (4) The perception is complex,

¹ Uphues is wrongly credited with the formulation on p. 178.